
ON
THE WATER SUPPLY
OF MONTREAL AND ITS SUBURBS.

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ON THE WATER SUPPLY OF MONTREAL AND ITS SUBURBS.

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(Read before the Natural History Society of Montreal, April 28th, 1879.)

In order to render this review as complete as possible, I will commence by quoting the analyses of Dr. T. Sterry Hunt, in his report to the Water Committee of this city in 1854.

The samples were collected in the months of March and April, and gave the following amount of mineral matter per imperial gallon after destruction of the organic matter by heating to redness. These results are interesting for comparison with more recent analyses :

	R. Ottawa Ste. Anne's.	St. Lawrence Cascades.	Lachine.	Old City Water Works.
Mineral matter per gallon. }	3.73	10.76	8.41	9.62

Dr. Hunt, in his report, states that the amount of chlorides found in the city water taken from the old works on Commissioners street always contained an excess of chlorides over the water of the St. Lawrence, showing local sources of impurity, probably due to the drainage of the city.

The nature of the organic matter does not appear to have been very closely investigated ; but it is suggested that it was of a vegetable and harmless character.

In the very valuable and elaborate reports of the Geological Survey, published in 1863, Dr. Hunt furnishes us with fuller analyses, and makes the following "comparison" of the waters of the Ottawa and the St. Lawrence :

"The comparison of the waters of the two rivers shows the following differences: the water of the Ottawa, containing but little more than one-third of the solid matter of the St. Lawrence, is impregnated with a much larger quantity of *organic matters*, and contains a large proportion of *alkalies* uncombined with *sulphuric acid* or *chlorine*."

The organic matter determined by loss after ignition was estimated as follows :

	Ottawa R.	St. Lawrence.	Lachine.	River front of City.
Grains of organic matter per gallon. }	1.11	.98	1.49	1.29

We have, therefore, on the best authority, the condition of the old water supply and of the river waters in question before the present works were completed.

My own analyses date from 1870 ; but the first series of results which I now submit were made in 1872, from samples of water which I collected myself during a trip from Niagara, in the month of June of that year.

The quantity of water at my disposal was too small to determine the organic nitrogen ; but as a record of the solid contents of the waters of the St. Lawrence it may possess some interest.

	Organic Carbon.	Mineral Salts.	Total.	Hardness, by Clark.
River Niagara,	1.10	6.60	7.70	3.5°
Lake Ontario,	1.01	6.50	7.51	3.3°
Toronto Bay,	* 2.50	8.50	11.00	4.5°
St. Lawrence, Long Sault,	1.20	6.60	7.80	3.3°
Do Pointe Cascades,	1.20	6.60	7.80	3.5°
Do S. Shore Aqueduct,	1.20	7.60	8.90	3.5°

* Containing nitrogen.

With the exception of the water of Toronto Bay, these waters are all clear and pellucid, and run sufficiently near in mineral contents to justify us in accepting the mean as a fair estimate of the quality of the St. Lawrence water. This gives us an average of about 1 grain per gallon of organic carbon, and 7 grains of mineral matter for St. Lawrence water above Lake St. Louis, in the month of June, 1872. In water taken from near the south shore, in May, 1873, I found :

Organic Matter.....	1.1
Mineral Salts.....	7.8
Hardness, 3.5°	8.9

In December, 1879, water from the inlet of the Longueuil water works gave me :

Organic Matter.....	1.5
Mineral Salts.....	10.0
Hardness, 6°	11.5

In May, 1879, water from the same point, as supplied from the Longueuil water works, contains :

Organic Matter.....	2.03
Mineral Salts.....	9.72
Grs. per imperial gallon,	11.75
Hardness, 6.25°, Clarke.	

(At this time the river was pretty full and brimming the wharves at Montreal.)

From the above it will be seen that the water gains 3 degrees in hardness on the south shore between the Lachine rapids and Longueuil, while there is no great increase in mineral lime solids.

The alkaline silicates disappear in the dried residue, and saline chlorides and sulphates are increased in quantity.

These are indications, therefore, that the water at Longueuil is somewhat affected by passing the city, but not to such an extent as to render the water unwholesome, although it would be much safer if sand filtered.

On the other hand, the water at Hochelaga gives considerable indications of nitrogenized impurity, the result of animal decay, and it is doubtful whether simple filtration would render it fit for human consumption. It is evidently affected by the sewage of the city both near the shore and in mid-stream. Any attempt to utilize it for a water supply would be attended with great expense, and still involve some risk of typhoid impurities.

WATERS OF THE NORTH DISTRICT.—1872 and 1873.

In contrast to the table of the waters of the St. Lawrence and the south shore, the following analyses of the waters of the north district will be found of interest, showing that, whilst the lake waters are of remarkable purity being taken at a great elevation and above the ordinary sources of impurity, the river waters of the north district which drain from the Laurentides, all contain alkaline silicates, and are slightly coloured with organic spores giving a yellow marsh-like tinge, to the waters. These waters, when conveyed for some distance in iron pipes, become of an ochreous tinge, from the precipitation of the vegetable matter in solution, which is unpleasing to the eye and somewhat difficult of filtration. A water of similar character has been introduced into Liverpool, England, and was for some time disliked on account of its peculiar color; but it has proved a wholesome and useful water, and the color is no longer deepened by the iron pipes which convey it from Rivington, a distance of twenty-five miles.

The waters of the north district gave the following results per imperial gallon :

	Organic Carbon.	Mineral Salts.	Total.	Hardness, by Clark.
Lake Kilkenny,	1.10	2.15	3.25	0.5
Lake Masson,	1.05	2.05	3.10	0.5
Rivière du Nord,	1.80	2.70	4.50	1.2
River Ouareau,	2.05	3.95	6.15	1.1
River Ottawa,	1.90	2.30	4.20	1.3
Do at Ste. Anne,	1.80	4.40	6.20	2.5

The Lake waters were perfectly colourless, while the River waters were more or less tinged.

The waters which supply the city of Montreal and the municipality of St. Cunegonde are taken from the aqueduct on the north shore of the river, just below Lachine, and are the mingled waters of the St. Lawrence and of the Ottawa Rivers in varying proportions at different periods of the year.

During the winter months the waters of the St. Lawrence are higher and more uniformly fed than those of the Ottawa : being confined under the ice, they therefore displace the Ottawa water, and, pressing over the rapids at Ste. Anne, they drive the northern waters chiefly over the "Back River" to the north of the Island of Montreal. The extent of this diversion depends partly upon the grounding of the ice about the western shore of the Isle Perrot and the ice block at Lachine rapids, circumstances which differ in extent and duration at every season, and contribute to the frequent variation of the character of the water supply at Montreal. This difference is more apparent in the color, flavor and comparative clearness of the water than in the results which appear by analysis of the salts which they contain,—the chief difference being in the organic constituents and in the aëration by carbonic acid, and in the presence of alkaline silicates or their neutralization by calcium salts.

The present system of supply on the rising main exaggerates the evil of a mixture of incompatible waters by carrying into all the houses below the level of St. Catherine street the suspended matter or dirt, with its accompanying disgusting lower organism, which fill the pipes and accumulate in the closet cisterns, especially in the spring, when the ice breaks up and renders the water muddy, and again during the heavy rains of the fall.

Of this suspended matter, my friend Dr. G. P. Girdwood has published a record in the *Canada Medical Journal*, Vol. vii, page 102, showing that in three months' ordinary summer supply the average daily deposit of *insoluble mud* varies from 2 grains to 4.8 grains per gallon, while under the exceptional circumstances of disturbance, the amount rises as high as 14 grains per gallon. As inhabitants of this mud, he enumerates fifteen forms of animal life, which he found in addition to those which I had previously described in the *Canadian Illustrated News* (Dec. 7, 1870).

The following table gives the result of analyses of the Montreal water supply in recent years, and during different seasons of the year :

TABLE OF ANALYSES OF MONTREAL WATER SUPPLY.

DATE OF COLLECTION.	LOCALITY.	TOTAL SOLIDS PER IMPL. GALLON.	ORGANIC CARBON.	MINERAL SALTS.	HARDNESS BY CLARK.	ALUMINOID NITROGEN, PER MILLION BY NESSLER.	APPEARANCE.
May, 1872	Water Workshops -	14.01	4.01	10.00	2.7	.001	Turbid, discolored —river high. do.
Sept., 1872	Wheelhouse -	9.25	2.00	7.25	2.3	.001	Turbid.
Feby, 1873	Laboratory, Beaver Hall	8.50	1.00	7.50	3.6	.001	Clear.
June, 1873	do.	9.10	2.90	7.10	3.8	.010	Clear.
Sept., 1873	do.	7.25	1.00	6.25	3.0	.010	Clear.
Feby, 1874	do.	9.10	1.50	7.60	3.8	.001	Turbid.
Dec., 1874	High Level Reservoir -	6.50	.50	6.00	3.0	none.	Very clear.
Dec., 1877	Laboratory, Beaver Hall	8.60	1.00	7.60	2.5	trace.	Clear.
Jan'y, 1878	do.	9.10	1.00	8.10	3.0	trace.	Clear.
March, 1878	do.	9.50	1.00	8.50	2.0	.010	Turbid.
July, 1878	do.	8.00	1.50	6.50	2.5	trace.	Clear brown.
Nov., 1878	do.	7.50	1.50	6.00	2.0	trace.	Clear.
Jan'y, 1879	do.	5.95	2.15	5.80	0.6	trace.	Clear.
April 7, 1879	do.	11.20	4.90	6.30	1.75	1.00	Turbid and very impure.
April 24, 1879	Service at I. R. Office -	8.05	1.40	6.65	2.50	.03	Nitrogen in excess.
May 9, 1879	Hydrant at St. Cuneconde	6.80	2.10	4.70	3.25	.02	Not clear. Nitrogen in excess.

It will seen from this table of analyses that the Montreal water supply is a most valuable product, and that it often contains excess of mineral matter in suspension, and sometimes organic debris from local or temporary causes. A far more wholesome water supply would be secured from the same source by the addition of settling beds of masonry and filter beds of gravel and sand after the Liverpool model, which I am informed should not cost more than 10 cts. per 1000 gallons, and would certainly contribute largely to the health of the inhabitants and to the hygienic reputation of the city. Moreover, upon other economic grounds, this is a wise and prudent improvement, which has been too long denied to the well-taxed public of Montreal. This I have urged to the successive Mayors, Chairmen of Boards of Health, and of the Water Committees, and I wish once more to urge these considerations on the municipal and sanitary authorities.

The waters of the Ottawa and of the north district generally which flow past Montreal island are remarkable for the sandy or flinty character of their minute animal and vegetable organisms, and for the presence of alkaline silicates, which when co-mingled with the waters of the St. Lawrence become precipitated into gelatinous hydrate of silica. As the result of frequent microscopic examinations of the deposits formed by subsidence of the water supplied to my laboratory, and also the deposits separated by the process of filtration in my house filter, I find that the deposits consist of

1. *Angular fragments of sand and flint.*

2. *Gelatinous silicious magma.*

3. *Organic silicious filaments of Diatoms, also spicules and gemmules of fresh-water Sponges and skeletons of Algæ.* This deposit resembles in general character the well-known "Tripoli powder" used for the burnishing of metals, the keenness and polishing power of which, is due to the presence of similar vegetable sandy fragments, which are scarcely less hard than "Emery powder" and will cut fine scores in the brass work of taps and valves, which, followed by hard particles of sand, give rise to continual leakage.

Therefore, I submit that the filtration of the water, *before it is pumped into the mains of the city*, would, by removal of this *gritty flinty matter* accomplish a *saving of waste* alike in water, taps, valves and working machinery, which would *more than repay*

the cost of filtration, and prove at the same time a great sanitary benefit. With regard to the *cost of filtration* I ascertained when last in Liverpool, that the cost of filtering 11 millions of gallons per diem, including cleansing and change of filters and interest of Capital, involved a comparatively small outlay and was maintained at a rate of £1250 sterling per annum, say \$575 per annum for each million gallons per diem. The balance of the Liverpool supply is drawn from well water naturally filtered through the red sandstone rock.

Under the intermittent system the consumption in Liverpool was on the whole average $33\frac{1}{2}$ gallons per head, per day; in certain districts 58 to 69 gallons per head per day. Under the constant service system this fell to $19\frac{1}{2}$ gallons per head per day. Under the system of district meters and inspection this is now reduced to 12 gallons per head per day, with a constant, more uniform and ample supply. Now a consumption of $33\frac{1}{2}$ gallons per head per day indicates a waste of 21 gallons per head per day and this saving is effected at a cost of one farthing per 1000 gallons, whilst an additional supply must be reckoned to cost from 5d to 6d per 1000 gallons.

I venture to think that the adoption of the Liverpool district plan in Montreal, of which filtration is the first element, would

- 1stly. *Double the available supply.*

- 2ndly. *Afford also, a spare head of water for flushing sewers and cleans. streets.*

- 3rdly. *Improve the sanitary condition* of the city by the supply of *filtered water* and thus guard against prevailing endemic and threatened epidemic disease, reduce the rate of infant mortality, and promote the general health and sobriety of the citizens at large.

Next to a really satisfactory supply of water to the city, the important and increasing necessities of the suburban districts demand consideration and timely relief. Either by extension of the city limits or by developments of the water supply to the suburbs, it is obvious that some better provisions for water supply ought to be made for those who very wisely forsake the crowded streets and lanes of the city and resort to the beautiful and healthful suburbs of Montreal Mountain. Why should not a head of purified water be here maintained sufficient to supply the whole island of Montreal? A liberal and enlightened municipal policy would not rest content with the present area of dis-

tribution, but would seek powers by which this water should be accessible in every direction, in which enterprize may seize upon a good locality, in which to plant real estate.

In the district of Hochelaga, the future Leith of our city, we have, as shown in an earlier portion of this paper, cut off the inhabitants from a reasonable enjoyment of our common river, by impregnating the same with sewage at the new outlet of Colborne avenue.

We also stand in great danger of permanently contaminating the water of Longueuil, and therefore the extension of the city southward; and the projection of the sewage at a more northern point much beyond the present will be an absolute necessity in the near future. For the provision of an ample supply of good water the municipality of Hochelaga have made diligent search, but no available source has been discovered nearer than the Back river. Hochelaga must therefore depend on Montreal for a water supply.

The district of St. Cunegonde at the west also requires water, and a large water supply. The farm of Prof. Macgregor at Braeside furnishes a remarkable spring, which would afford a wholesome and large supply of water from the Laurentian hills on the north.

My analysis of this spring, made in April last, gave the following result:

Total solid contents per imperial gallon	-	31.30
Hardness by Clark, 19°		
Albuminoid nitrogen	- - -	no trace.
Carbonate of lime and magnesia	-	22.00
Organic carbon	- . - -	1.75
Silicious carbon	- - - -	2.30
Silica wh. iron and alumina	- -	.10
Chlorine (combined)	- - -	1.72
Sulphuric acid do.	- - -	.73
Alkaline bases	- - - -	2.70
		31.30

This is a very excellent water, but rather hard for domestic and industrial purposes. I am informed that the flow of the spring is equal to about 4000 gals. per diem.

At Cote St. Antoine, outside the city limits, the residents are supplied by water carts, which are sometimes replenished from

the flushets of melting snows in neighbouring fields, sometimes from the canal direct. These carted waters are usually very impure. The water flowing from Montreal mountain is however of good quality. At the Mile End also, water carters purvey water from the quarry ponds, full of animalculæ and vegetable matter, which is unfit for domestic use.

At Mount Royal Vale surface water is collected which is well mingled with clay, and when clear this water appears to be of good quality but rather hard. An analysis of this water in April last, gave the following result :

Organic carbon	-	-	4.20
Carbonate of lime	-	-	14.40
Silica and alkaline salts	-	-	2.40

Hardness by Clark 14°	21.00
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At Lachine also, better waters, although somewhat harder, are obtained from local wells than from the river water. I found that in the month of March, 1878, the river water gave

Organic carbon	-	-	3.1
Mineral salts	-	-	9.6

12.7 grains,

and that it also contained excess of albuminoid nitrogen.

It would therefore appear highly desirable for the hygienic welfare of our suburban residents and our summer visitors, that the Montreal water works should be considerably extended, and the filtered water distributed from our mountain reservoirs to the whole outlying districts. This *great improvement*, which I have consistently and persistently advocated for some years, I hope to live to see an *accomplished fact*.